



# Formation and geography of science-industry collaborations: the case of the University of Poitiers

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# The build-up of science-industry partnerships and their geography

JEL : O31, O39, R12

**ABSTRACT** This paper tries to elicit elements which explain the geography of science-industry collaborations by focusing on their construction process which is rarely studied regarding the existing literature. Constraints linked to the search of resources, on the one hand, and constraints linked to the logics of contact, on the other, weigh on actors when choosing their partner and could influence the geography of collaborations. An empirical study on collaborations established between Poitiers University's laboratories and firms confirms this hypothesis. Cognitive constraints lead to the spatial dissemination of collaborations. An econometric model shed light on the impact of logics of contact and shows that whereas most of these logics enable the construction of local and non local partnerships, non professional ties favor significantly local ones.

**KEY WORDS:** Collaborations, geography, social networks, institutions, resources

## **1. Introduction**

Collaborations became crucial in the innovation process of firms by allowing for the combination of heterogeneous skills required for a specific project. This element of collaboration is revealed in the increasing number of research partnerships established (Hagedoorn and al., 2000 ; Frenken and al., 2005). The University is a key partner, since it constitutes a source of new knowledge (Feldman, 1994 ; Saxenian, 1994; Anselin and al., 1997). The very first scholars of the geography of innovation draw attention to the significance of firms to locate close to universities to absorb knowledge: they consider that tacit knowledge is difficult to transmit from a distance. For some years, recent studies in this field of research, criticize this latter argument (see Breschi and Lissoni (2001) notably) and show how local and non local relations co-exist (Audretsch and Stephan, 1996 ; Autant-Bernard and Massard, 2000 ; Grossetti and Bès ; 2001 ; Levy, 2005).The debate always exists about the geography of knowledge collaborations and the authors mainly focused on constraints linked to the exchange of tacit knowledge to advance the debate.

Continuing the work of these researchers, this paper attempts to enrich the literature about the geography of innovation by testing determinants generally neglected, which appear before the exchange of knowledge. We think that the geography of the knowledge collaborations is also influenced by constraints which take place during the formation process of partnerships: constraints linked to the search of resources, on the one hand, and constraints linked to the modalities of connection with the partner, on the other. It appears that in most cases, project leaders look for a particular resource when looking at their innovation project and they consequently choose a partner within a very limited group. In other cases, companies may decide to collaborate with a laboratory after having recruited a former PhD student. Hence, cognitive constraints and logics of contact, in this case the social

relations of the researcher, could influence the choice of partner and determine the spatial dimensions of the collaboration.

We try to measure in this paper what are the weigh and the spatial impact of cognitive constraints and logics of contact. By doing so, we could give new explanations of the collaboration process and its geography. In this purpose, we develop an analytical breakdown which identifies determinants linked to the construction of partnerships and determines their potential effect on the geography of partnerships. This theoretical framework is mainly based on the resource-based view of the firm (Penrose, 1959; Nelson and Winter, 1982) to highlight cognitive constraints. We also insist on new insights of the structural sociology (Granovetter, 1973) to identify three vectors of contact: renewed collaborations, social networks and micro-institutions.

These theoretical hypotheses are supported by an empirical study based notably on a database of 115 partnerships made between the research laboratories of the University of Poitiers and firms. Thanks to semi-directed interviews, consisting in reconstructing collaborations stories, a qualitative analysis allows us to identify the formation process of partnerships. By this way, we can assess the importance of cognitive constraints and the role played by the different logics of contact (social networks, institutions and renewed collaborations). Thanks to an econometric treatment of our database (a binary logit model), we can draw conclusions regarding the links between the possibilities to contact a partner and the geography of partnerships and deduce the spatial impact of these modalities of connection. Four main results are revealed: i) laboratories of the University of Poitiers collaborate with both close and distant partners; ii) cognitive constraints strongly influence the choice of the partner and explain a part of the geography of partnership observed; iii)

logics of contact do not determine strongly one spatial level and allow the construction of local and non local collaborations; iv) spatial impact of social ties depends significantly on their nature.

In this paper, initially we give an overview of the theoretical and empirical studies carried out in this field of study. We then present our theoretical hypotheses. Thirdly, we develop our empirical model and indicate the methodology applied to obtain qualitative data, create our database and realize our econometric model. We finally present our results and our conclusions.

## **2. Empirical and theoretical backgrounds**

For a few years now, several scholars have analyzed science-industry collaborations (Joly and Mangematin, 1996 ; Carayol, 2003 ; Levy and al., 2009; Giuliani and Arza, 2009) since these latter are crucial in the innovation process of firms and more generally in the territories development. Some authors focus more particularly on their spatial dimensions and reveal firstly their local pattern. Indeed, the very first scholars of the geography of innovation (Jaffe, 1989 ; Acs and al., 1992) have observed that firms benefit from knowledge externalities when situated close to universities. They conclude that “knowledge cross corridors and streets more easily than ocean and continents” (Feldman, 1994) and show the benefits of the spatial proximity. Based on the evolutionary theory, they explain that reduced distances between actors enable to cut costs linked to interactions and favor the exchange of tacit knowledge.

For some years, some doubts have been expressed on these previous empirical and theoretical analyses. Breschi and Lissoni (2001) highlight several limits : they criticize the

classical dichotomy between local interactions and tacit knowledge, on one hand, and distant interactions and codified knowledge, on the other. Rallet and Torre (2007) have shown the risks linked to the co-location of innovation activities and the relevance of a temporary spatial proximity thanks to ICT for instance. Others have noted that extra-regional collaborations – allowed by belonging to an epistemic community (Amin and Cohendet, 2004) and/or by knowledge gatekeepers (Rychen and Zimmermann, 2008) - are strategic (Owen-Smith and Powell, 2002). Empirical studies recently highlight distant linkages (Morrison, 2008; Ponds, 2008) and show the co-existence of local and non local science-industry collaborations (Audretsch and Stephan, 1996 ; Autant-Bernard and Massard, 2000 ; Levy, 2005). To better understand this geography, authors always focus on the exchange of knowledge and they generally neglect other potential determinants which appear during the partnerships build up. Only a few authors have questioned the modality of connection with partners in the geography of collaborations. Analyzing the genesis of science-industry partnerships, Grossetti and Bès (2001) showed that local would result from local social relations between firms and researchers.

Our study is inscribed in the continuity of these scholars and tries to go a step further: we want to bring new explanations of the geography of science-industry collaborations thanks to a detailed analysis of the logics of connection with partners and more generally of the construction of collaborations. In other words we search to understand more precisely how and why collaborations are established. By doing so, we want to underline new potential determinants of the geography of collaborations which result from constraints linked to the resources searched and the modalities of connection with partners.

### **3. Theoretical hypothesis**

The theoretical framework aims to highlight the built up of knowledge collaborations. The formation of partnerships in general has already been studied (Stuart, 1998; Ahuja, 2000b; Tether, 2004; Giuliani et Arza, 2009) but we want to insist on two constraints as considered to be structuring in the geography of knowledge collaborations: constraints linked to the search of complementary resources and constraints linked to the modalities of connection with partners.

In this perspective, we adopt an “interactionist” approach (Kirman, 1998) in which the elementary unit of the analysis is not only the individual but also the relation between actors (Zimmermann, 2008) and we make the assumption that actors act out of limited rationality (Simon, 1959). Individuals only have access to a limited number of information (because of individuals’ incapacity to take into account and access all the information and due to the costs associated to collecting these data). Instead of making their decisions by having access to a whole set of possibilities, they just rely on a sub category. To be more precise, we consider actors act according to a contextual rationality (March, 1978) also called situated rationality (Orléan, 1994; Pecqueur and Zimmermann, 2004). Choices made by the different actors - concerning the identification of the complementary resources required and the selection of the partners - depend on their situation in a socio-economic space. This hypothesis appears to be crucial in the formation process of collaborations and allows to highlight constraints that weigh on actors during this step.

#### *3.1 Constraints linked to the search of complementary resources*

We consider innovation as an interactive and collective process. Indeed, the process involving the creation or integration of innovations more and more requires a set of heterogeneous skills, especially considering the complexification of the products elaborated. The internal cognitive dynamic of a firm prevents the development of that set within the firm itself (Penrose, 1959). It is led to specialize on its core competencies to be able to keep its competitive advantage (Nelson and Winter, 1982). Firms, constantly on the lookout for innovation, are compelled to look for complementary resources from outside (Richardson, 1972).

Therefore, during the construction of their collaboration, actors integrate in their choices cognitive constraints. The selection of a partner depends on resources needed which could be located in a particular territory. This underlines the relevance of the geography of resources which favors, in general, territories which concentrate numerous resources like capital regions and major cities. Other regions, which gather only few resources, on the contrary, have a disadvantage, like the Corse region (see Torre, 2000), and must necessarily develop extra-regional collaborations. Indeed, these latter kinds of regions have fewer opportunities to find locally a partner since their resources are limited in their global number and specialized in a restricted number of industrial sectors or scientific domains. Moreover, we consider the higher the degree of the resources specificity, the higher the cognitive constraints in the geography of collaborations. Specific resources correspond here to assets physically localized within a particular territory in the sense of Williamson (1985).

### *3.2 Constraints linked to the modalities of contact with partners*



Another crucial aspect during the formation process of collaborations on which we want to insist here is the modalities of contacts between the different partners. The logics of connections make the potential choices (more or less limited according to the degree of the specificity of the searched resources) effective. Taking into account the socio-economic embeddedness of actors, we consider three logics of contact: (i) renewed collaborations, social network, (ii) social networks and (iii) micro-institutions (see Fig.1).

Figure 1

(i) Renewed collaborations could be considered as to be an important mean to find a partner. Some authors showed how they shape the establishment of partnerships in the future (Powell and al., 1996, Stuart, 1998, Ahuja, 2000b). Regarding the costs involved in looking for new partners, we can suppose actors have an advantage to resort to partners they already worked with. The reactivation of past collaborations gives advantages in terms of cost (transaction costs notably (Williamson, 1985), learning (Dosi and al., 1990) and trust (Granovetter, 1985). In most of cases, when it is possible, we guess actors choose their partners among a sub-category established from these already existing economic relations and rely on their experience<sup>i</sup>. A study led on the French technological diffusion networks underlines the firms preferences for partners with whom they already have collaborated with, even distant (Rallet and Torre, 2001). This underlines the inertia of actor's behavior, the "path dependant learning trajectories" (Maskell and Malmberg, 1995) and the existence of lock-in effects (Arthur, 1989). On the contrary, if the organization is not satisfied, it will turn to its personal relations or to institutions to find and connect with its partner.

(ii) The studies led in structural sociology are highly valuable to the geography of innovation because they show that the economic activity is embedded within personal ties and social

interaction structures. Social networks, or in other words a social proximity (Boschma, 2005; Bouba-Olga and Grossetti, 2008), facilitate exchanges and the development of contacts between the different actors. Granovetter (1973, 1985) gives an account of how actors have access to certain resources thanks to the introduction of the concept of “social embeddedness<sup>iii</sup>”. Through a study conducted on the US job market, he shows that interpersonal ties make it easier to find a job, 56% of the jobs were found through networking. In our study, the notion of social network, more and more frequently used in social sciences, will refer to a set of direct or indirect interpersonal relations (Grossetti and Bès, 2001). Following Granovetter (1973), some authors (Burt, 1992; Ahuja, 2000a; Fontes and al., 2009) show the necessity to distinguish strong and weak ties, on the one hand, and direct and indirect ties, on the other, considering their efficiency is different to access resources. We also consider the importance to differentiate social ties according to their nature (eg. teaching relations, professional ties and non professional ties (see the typology in appendix 1)) considering their potential differences to access partners.

(iii) Institutions, acting as functional substitute for trust (Granovetter, 1985), become an alternative solution to social networks. They also facilitate the development of contacts between actors by acting as an interface between organizations. To be more exact, macro-institutional structures create a system that conditions technological changes; they either act as a facilitator or a constraint since they represent the environment where socio-economic relations can take place (Amable and al., 1997). These macro-institutional structures materialize in micro-institutions which operate as a mediator between the different partners. In other words, a proximity, which can be qualified as institutional (in the meaning of Bouba-Olga and Grossetti (2008) notably), facilitates the development of collaborations. We have retained a restrictive definition of these micro-institutions or

“mediation resources<sup>iiii</sup>”: they represent “everything that allows exchanges without resorting to networks of personal ties” (Bouba-Olga and Grossetti, 2008). Professional trade fair, congress and public structures (such as CRITT in France) seem to be relevant modalities in facilitating university-industry linkages, as Grossetti and Bès (2001) already showed.

These three logics of contact are interdependent and tend to be assimilated by some authors. By doing so, they forget about some fundamental aspects and it prevents to show their different spatial impact in the geography of knowledge collaborations. We consider that the impact of the logics of contact heavily relies on the geography of renewed collaborations, social networks and micro-institutions. . Concerning the renewed collaborations, few scholars give an account of their geography. However their geography could influence not only the existing geography of knowledge collaborations but also its dynamic: according to their spatial dimension, renewed collaborations could lead to the spatial agglomeration (if actors mainly renewed local collaborations), to the spatial dispersion (if actors mainly renewed non-local collaborations) or reinforce the existing geography (if actors renewed local and non local collaborations as much as previously). To complete the analysis of the spatial impact of renewed collaborations, we have not only to determine their spatial dimensions, we have also to analyze their genesis by getting back to the very first contacts developed between the actors in order to specify if these contacts have been initiated through social networks or micro-institutions, because the geography of renewed collaborations relies on the geography of the logics of contact they have originally permitted them. A great number of scholars has highlighted the local aspect of social networks (Fischer, 1982; Grossetti, 2002). Yet, they may also be transnational (migratory networks) and distant ties could be more and more often maintained thanks to ICT. Therefore, « social relation may develop among social actors at different spatial levels »

(Lorentzen, 2007). Others insist on the national aspect of institutions (Lundvall, 1992; Amable and al., 1997; Bathelt and al., 2004) although they tend to develop increasingly on a regional level.

#### **4. Empirical analysis: data and method**

Our empirical study rests mainly on a database built up with qualitative information about collaborations between researchers of the University of Poitiers and firms.

The University of Poitiers is the main University of the Poitou-Charentes region and counts 50 laboratories and 934 researchers (the second University of the region, located in La Rochelle, is about four times smaller). Thanks to the University of Poitiers, the Poitou-Charentes region is relatively important in terms of public research. However, the region is quite small (regarding different size indicators, the region is the 15<sup>th</sup> region in France out of 22) and gathers, as a consequence, less enterprises. In addition, these latter are mainly SME's specialized in low-medium technology. Therefore, whereas the Poitou-Charentes is the fifth most important region in France regarding the weight of public researchers, the region is the 18<sup>th</sup> in terms of private researchers (MESR-DEPP, 2007).

##### *4.1 Collaboration stories: interviews and coding method*

To construct our database, qualitative information have been collected by a survey consisting in reconstructing the story of various collaborations established by the laboratories of the University Poitiers. 38 researchers have been interviewed and thus 114 collaboration stories have been reconstructed. Thanks to information provided by the center

of Poitiers promoting research, we interviewed first a group of researchers directly involved in research contracts<sup>iv</sup>. To have a representative sample, researchers have been selected according to the global distribution of contracts of the University of Poitiers by scientific fields and by localization of their partner. Then, complementary interviews were made with firms involved in the projects studied to confirm the story.

Interviews were carried out according to the method used by Grossetti and Bès (2001). We have reconstructed various collaboration stories through half-directed interviews (restricted number of open questions to focus the speech of the person interviewed on the particular theme) of about two hours long and carried out among researchers directly involved in the innovation project. The aim was to obtain key information regarding cognitive constraints and the initial meeting with the partners. Thanks to a first question (for instance “could you explain me the partnership with this firm?”), the people interviewed were supposed to give a personal account of the history of the project and describe the evolutionary phases of the collaboration process. Then, they were asked as much questions as necessary to provide further details about the reasons behind the choice of the partner and the coordination means used through precise questions about the selection criterion, questions meant to obtain an enumeration of relations (Who did you collaborate with to develop this project? Have you already collaborate with this partner? How did you manage to meet and select him? etc.).

More precisely, the explanations given to account for the existence of renewed collaborations and their birth reveal two distinct steps. The first phase of the process concerns the relations developed between the different partners when working on the collaboration project, which permits to assess the impact of the three major vectors involved

in the development of the relation (renewed collaborations, social networks and micro-institutions). The second phase focuses on renewed collaborations and goes back to the very beginning of the relation between the two partners; as a result, we can identify the channels through which the first collaboration took place (through social networks or micro-institutions). The two channels at the core of the development of the relation can be divided into sub categories (see the appendix for a clearer typology of the social networks and micro-institutions). Within social networks, three sub categories of social relations emerge: professional and non professional ties as well as teaching relations. As for micro-institutions, we have to distinguish between external and internal ones. The former corresponding to the external structures of the organization (congress, publications, etc.) and acting as a mediator and the latter corresponding to the internal structures of the organization which facilitate the development of relations (relations with subsidiaries, agreements between laboratories).

#### **Box n°1: A collaboration story**

##### ***Story 022: Collaboration between an automotive constructor (localized in Ile-de-France) and a laboratory in engineering science (L47)***

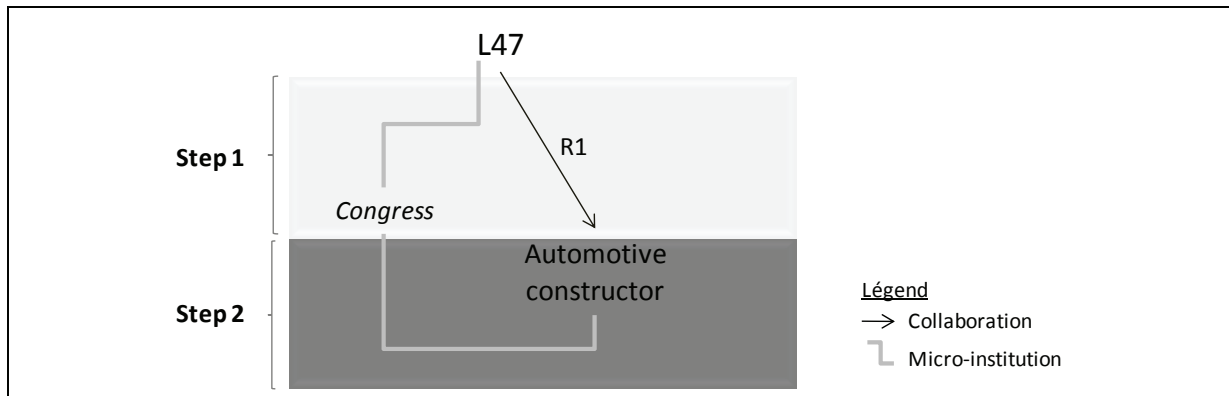
###### *Step 1*

*The partnership (R1) between the two partners is not new (they already collaborate once before). **The partners renewed a former one** for the new research project.*

###### *Step 2*

*The automotive constructor wanted to establish an aerothermic research about automotive breaks. The firm looked for resources which are quite rare: **“a really limited number of laboratories work in this research field”**.*

*One of the scientific responsible of the firm went to a congress where a researcher exposed his work about the item interesting the firm. « The scientific responsible was impressed by the results » explained the researcher. Hence, the industrial went to the researcher to discuss and to know if his laboratory could be interested in working with them about this subject. Hence, the contact was allowed by a congress which is considered as **an external micro-institution**.*



The interviews have been transcribed (notes were taken in shorthand) to reconstruct collaboration stories (for an extract of a collaboration story see the box before). Concerning the cognitive constraints, we extract the main idea to evaluate their strength: analyzing if the resources required induce different choices or not, we can deduce their influence in the partner selection and in the geography of the collaboration. For instance, in the collaboration story in the previous box, cognitive constraints are considered to play a role since the person interviewed quotes the limited number of potential partners. Concerning the logics of contact, information about them have been coded according to the theoretical breakdown presented before. In the previous collaboration story (see Box n°1), firstly, we code the logic of contact used in the first step (noted “renewed collaboration”), then, we code the initial logic of contact in the second step (noted “micro-institution”) and we add the precise nature of this logic of contact (noted “external micro-institution”). We also code the localization of the industrial partner and the research field of the lab. These data are finally put in a excel table (cf. infra).

Table 1

It allows to build up a database on which to carry out more systematic statistics: we will then be able to assess the weight of the different logics of contact and their impact in the geography of collaborations.

#### 4.2 Econometric treatment of the data: a binary logit model

To go a step further, we use this database to confront the nature of the initial conditions taking place in the formation of the partnership to the location features of the partners involved in the innovation project thanks to an econometric model. A binary logit model is realized to explain the geography of the collaborations studied by testing the type of the logics of contact. For this purpose, in this model, the dependant variable is the spatial dimension of collaborations, noted  $LOC_k$ , and the independent variables correspond notably to the different logics of coordination and their sub-categories (external micro-institutions, non professional ties, teaching relations, etc.). We add control variables which correspond to the scientific domain of research of the laboratories. These variables are all turned into binary variables.

More precisely, in this model,  $LOC_k^*$  is the latent variable and  $LOC_k$  is the binary variable whose value is 1 when the  $k^{ième}$  collaboration is established at the spatial dimension tested and the value 0 otherwise. The logit model is given as :

$$LOC_k = \begin{cases} 1 & \text{si } LOC_k^* \geq 0 \\ 0 & \text{sinon} \end{cases}$$

With  $LOC_k^* = \alpha + Z_k\beta + \mu_k$

Z is the matrix of independent variables and  $\beta$  the parameters vector. Hence, the probability could be written as:

$$P(LOC_k = 1|Z_k) = \frac{\exp(\alpha + Z_k\beta)}{1 + \exp(\alpha + Z_k\beta)}$$

Basic descriptive statistics of the model variables are provided in Table 2.

Table 2



## **5. Results and discussion**

### *5.1 The science-industry partnerships of the University: their multiscale dimension*

Before focusing on the formation process of knowledge collaborations, we provide background information on the spatial scales of collaborations and the context of the case study. For this purpose, we use a larger database which draws up a list of all the science-industry contracts signed with the various university laboratories of Poitiers from 2004 to 2007 and holds 287 contracts.

It appears that the number of contracts is stable during the period observed, around 70 contracts have been realized each year. These innovation projects are quite long (the average longer is 18 months) and with a high value (the average value is 45 000 euros). Regarding the nature of the partners involved, we can observe that engineering and chemical sciences are over-represented: 70% of the contracts are signed by laboratories of these scientific domains. Concerning the industrial partners, they are mainly firms belonging to aeronautic and automotive sectors.

Thanks to this database, we are also able to draw conclusions on the geography of collaborations established between Poitiers laboratories and firms. It reveals the multi-scale dimension of knowledge collaborations, given that the industrial partners of Poitiers University's laboratories are located on different territories. Non local collaborations are largely predominant and especially contracts signed on the national level (with around 80% of the contracts). On the contrary, the number of intra regional and international contracts is quite low, each respectively representing 11% and 10% of the contracts signed. This spatial distribution is relatively stable during the period studied.

On the national level, the industrials located in Ile-de-France can be considered as preferential partners. Elsewhere, the contracts have been signed with regional partners (about one fourth of the French partners) or with industrials located in Midi-Pyrénées, but to a smaller extent.

The results obtained from reconstructing collaborations stories are quite similar to those presented above (See Table 3); it confirms that the sample is representative considering the spatial scale of collaborations.

#### Table 3

Our results are similar to those revealed by two other previous studies established in other territories. By analyzing the spatial distribution of the contracts signed with the University of Strasbourg, Levy (2005) shows that local collaborations are few and that they co-exist with non local ones. An inquiry led by Grossetti and Bès (2001) (on the collaborations with CNRS researchers in five large French cities) reveals the same results. However, their study shows a higher representation of local collaborations (27%). That difference can be explained, at least to a certain extent, by the lower industrial density of our case study and its specialization. It underlines the relevance of the territorial context and structural patterns of regions where are located the actors to understand the spatial distribution of knowledge collaborations. We try to go a step further in the explanation of this geography of collaborations regarding cognitive constraints and the modalities of contact between partners.

#### *5.2 The resources searched: specificity and strong influence*

Most of the researchers interviewed quote the importance of resources in the selection process of partner: One says *"the partner has been selected for his resources"*. Another reports: *"collaborations with some industrials are obvious regarding their mutual research specialization"*. It highlights the existence of cognitive constraints which seem to be high because of the specificity of the resources searched. The number of industrial partners is limited and researchers have sometimes no choice because the resources required are rare. Cognitive constraints are higher since a great number of firms is not interested in fundamental research. Symmetrically, the number of potential scientific partner is low: researchers state to be specialized in a very acute field and some industrial problems are connected to a very specific scientific domain. An industrial spells out: *"I think the laboratory of Poitiers is the only one in France to work in this scientific field. I've never heard about another laboratory in this domain"*. Another explains also: *"more than one potential partner is really rare."*

Due to the strength of cognitive constraints, the geography of resources contributes to the spatial distribution of collaborations. Its impact appears regarding structural effects. In our case study, size effects (the agglomeration of R&D and industrial activities) explain the region Ile-de-France as preferential partner. Moreover, a part of the overrepresentation of contracts with the Midi-Pyrénées region could be explained by specialization effects: the industrial specialization of this region in aeronautic is compatible with the scientific specialization of the labs of Poitiers. These effects explain the limited number of local partnerships: *"collaborations are mainly at the national level, R&D enterprises are rare locally"*. The weight of the industry of the region Poitou-Charentes is almost the same than the French average but, as we noticed before, the region mainly includes small-sized production units specialized in medium and low-tech sectors. They are rather inclined to

look for short-term technical solutions than look for scientific innovation: *“local firms ask for small sub-contracts which do not interest researchers”*. Moreover, the industrial specialization of the region does not really seem compatible with the scientific specialization of the laboratories, though it is the case with some larger cities such as Toulouse. To really grasp the influence of these structural effects, a quantitative research design is necessary. Thanks to an original database which gathers information about more than 14 000 science-industry contracts in France, Bouba-Olga and Ferru (2009) realized a gravity model which confirms the strong impact of size effects in the geography of knowledge collaborations.

### *5.3 The logics of contact: construction and strengthening of local and non local partnerships*

Before focusing on the geography of the logics of contact, we determine the weight of each of these different logics in the collaboration process.

First important result, the 114 collaboration stories reconstructed reveal that in 61% project leaders turn to past collaborations, in 24% to micro-institutions and in 15% to social networks to choose their partner. A great number of partnerships exist for a long time given their advantages: *“renewed collaboration are really easy, we know each other”*. These historical science-industry relations are necessary for firms in which the turn-over of scientific responsables is important: *“the laboratory constitutes the memory of the research of the firm”*.

#### Figure 2

Second result, the analysis of the genesis of renewed and new collaborations reveals that both social networks and micro-institutions operate as two alternative modalities whose importance is almost similar: the social networks were at the origin of contacts with 53

partners against 62 for the micro-institutions. These results are very close to those obtained by Grossetti and Bès (2001) in spite of contextual differences of our areas of study. We have to precise, that partnerships built up through social networks are mainly initiated by a direct social relation.

When examining more precisely the nature of the social networks and micro-institutions having permitted the initial contact between partners, we note that the external micro-institutions and the professional and teaching relations play a major part in science-industry collaborations (See Table 3). The very first contacts often take place at a congress: in that case, industrials can get information on research carried out in a specific field of study. Former PhDs are also often at the origin of partnerships or they help the renewal of collaborations: a researcher states *“they are a key modalities”* and another adds *“they facilitate the relation with industrials because they know the lab resources”*. Indeed, they favor contacts between two really separate and distinct areas that are science and industry thanks to their knowledge of these two areas. Fleming and Frenken (2006), Todling and al. (2008) and Giuliani and al. (2008) also observe the relevance of former PhD recruitment in firms to favor science-industry collaborations.

#### Table 4

When we focus on the geography of these logics of coordination, we can notice first that renewed collaborations operate on various spatial scales. These latter have no different spatial patterns than the new collaborations: extra-regional collaborations represent 85% and intra-regional collaborations correspond to 15% of the contracts signed for both renewed collaborations and new collaborations. These results reveal, on the one hand, the inertia of actor’s behavior and the path dependant innovation trajectory and lead, on the

other hand, to the strengthening of the geography of collaborations observed. Concerning the social networks, we note that the partnerships originating from a personal relation are not necessarily local ones even if they are more local than those originating from a micro-institution. Contrary to what Fischer (1982) and Grossetti (2002) showed in their studies, we are unable to draw any conclusion regarding the local aspect of social networks. Concerning the micro-institutions, they don't seem to be linked to any particular spatial pattern, they lead both, to local and non local collaborations. Public structures created to promote territorial partnerships are rarely used by project leaders: only 5 out of 41 correspond to such micro-institutions.

#### *5.4 The nature of social ties: diverse spatial impact*

A logistic regression model allows to analyze more carefully the impact of these coordination constraints on the geography of collaborations by testing the existing correlation between one particular spatial scale of partnerships and each logics of contact. It mostly allows to evaluate the structuring role of the sub-categories of the logics of contact.

We test three versions of this model: (1) the first focuses only on the impact of renewed collaborations (noted RE\_COLLAB); (2) the second tests the effect of micro-institutions (noted MICRO\_INSTIT) in comparison with social networks; (3) the third takes into account the nature of the social networks and micro-institutions (noted INTERN\_MICRO\_INST, PROF\_TIES, NON\_PROF\_TIES, TEACH\_TIES). Spatial dimensions of collaborations are tested at the local level (inside the department), noted LOC\_D<sub>k</sub>, in the different versions of the model, and at the national level, noted LOC\_N<sub>k</sub>, in the last version. The table 5 sums up the results of the model.

Table 5

The two first versions of the model confirm the previous results: renewed collaborations do not lead to the spatial agglomeration of collaborations, contrary to some theoretical models (Krugman, 1991), neither their geographic dispersion. Moreover, as we showed previously, turning to social networks or micro-institutions do not contribute to one particular spatial scale. The third version of the model gives new findings and underlines the necessity to distinguish social networks according to their nature, their impact on the geography of collaborations being different: using non professional relations to access to a partner give a probability ten times higher to collaborate locally (inside the Vienne department) whereas turning to professional relations favors collaborations with a French partner located outside the Poitou-Charentes region. The non local dimensions of professional ties and teaching enable to establish trans-territorial collaborations. The industrial and scientific density in our area of study accounts for the fact that the recruitment of former PhDs and the exchange of researchers by local companies are limited. This could explain the weakness of local collaborations initiating by teaching relations and professional ties. Therefore, not all social relations facilitate local collaborations but only non professional ones.

Finally, logics of contact contribute to the geography of knowledge collaborations observed but contrary to existing scholars they do not lead to one particular spatial dimension. It is necessary to analysis the logics of contact more precisely to better understand their impact in the geography of collaborations.

## 6. Conclusion

The aim of this paper was to go a step further to scholars which study the geography of knowledge collaborations by focusing on determinants rarely studied. Constraints which weigh on actors during the formation process (constraints linked to the search of resources and constraints linked to the modalities of contact of partners) of science-industry collaborations could impact, at least to a certain extent, the geography of these relations. For that purpose, we have analyzed the relations between science and industry and carried out a qualitative study of the collaborations formed between the Poitiers University's laboratories and firms.

After showing the science-industry relations operate on different territories, it results that constraints that weigh on actors during the collaboration build up explain a part of the geography of collaborations observed. Constraints linked to the search of resources are strong due to the specificity of the resources required in innovation projects. Hence, the geography of resources is all the more structuring and leads, in our case study, to the spatial dissemination of knowledge collaborations. The logics of contact contribute also to the spatial distribution of the geography of collaborations. In most of the cases (61%), actors turn to past collaborations to find a partner. The genesis of renewed collaborations reveals the importance of social networks and micro-institutions to initially access partners. These latter enable the construction of both local and non local partnerships and participate to the multi-scale dimension of knowledge collaboration whereas renewed collaborations strengthen this geography. We have showed the necessity to distinguish the sub-categories of social networks to better understand their spatial impact. Contrary to the existing studies, social ties do not systematically favor the spatial concentration: non professional ties only would give a higher probability to collaborate locally; on the contrary, professional



ties would promote extra-regional collaborations. In other words, this paper shed light on the relevance of the institutional and relational proximities in the formation of knowledge collaborations and their impact in their geography. Nonetheless, it did not test the irrelevance of spatial proximity despite the weakness of local partnerships. Spatial proximity effects should be analyzed properly and compared to non spatial ones.

We have to precise that our empirical study only focuses on the collaborations developed with a single university with its own characteristics. Hence, it is not possible to generalize our results to all knowledge collaborations and all the more that we consider actors act according to a situated rationality. Due to the relevance of the socio-economic and territorial context, it seems to be necessary to multiply case studies to highlight similarities and differences.

## APPENDIX

### Categories of social networks and micro-institutions

Categories of relation ties	Sub-categories
Non professional ties	family, childhood, non professional organizations, friends
Teaching relations	Teachers, former students
Professional ties	Former co-workers in research, former co-workers in firms

Micro-institution	Sub-categories
Internal	Relationships linked with the firm or lab structure
	Economic relationships (with suppliers, subcontractors, consumers)
External	Public institutions (CRT, CVR, D2RT, Oséo, etc.)
	Private structure, experts
	Professional organization (club, technological associations, commissions of specialists)
	Projects ("pôles de compétitivité")
	Congress, scientific or professional meetings, etc.
	Medias (press, internet, publications, etc.)
	Reputation
	Training period market
	Market (invitations to tender)

## NOTES

1. "These procedures and routines are based on the firm's interpretation of its successful behaviour in the past and will continually be reproduced and reinforced as long as they seem reasonably efficacious" (Maskell and Malmberg, 1995).
2. This term had already been used by Polanyi (1944) – it was meant to highlight the principles underlying the transfers of resources in the relations (reciprocity, redistribution and market).
3. This concept, originally created by Hennion (1993) and used by Cochoy (2002) in his work on commercial mediations, was later used by Grossetti and Bès (2001) to qualify the modalities of the contacts established between the actors within innovation systems.
4. Researchers more and initiate the collaboration and search for industrial partners.

5. The economic relationships (when they are sufficiently « routinized » and « contractualized » to be integrated in the firm organization and when they can be considered as an inter-organizational relation) and the financial relationships couldn't be considered as personal ties since they are not inter-individual ; they also must be differentiated with external micro-institutions, the internal structure acting as a mediator.
6. We have to precise, in some cases (16), they turn to both solutions, hence a total number of elementary collaborations reaching 130. Indeed, new collaborations can emerge from two similar or different coordination vectors and of equal importance in the development of the relation.

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